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A method and an apparatus for transfer of pressure and/or tensile load and an elongate chain for use therein.

The present invention relates to a method and an apparatus of making an elongate spindle member having significant rigidity and stability against pressure and/or tensile loads as well as bending and torsional loads, whereby said spindle member acts between two objects.

According to the invention a transfer of pressure and/or tensile and possibly torque loads between two mutually movable objects is provided, which is suitably applicable for a number of practical purposes and based on hitherto unknown mechanical principles. Non-exhaustive examples of fields of use aimed at by the invention may be raising/lowering devices for mutually height displaceable objects, for instance jacks or motor-operated lifting devices of any kind, and operator mechanisms for the opening and closing of windows, doors and gates.

The method according to the invention comprises the steps of

- winding-up of a plurality of mutually interlocking chain links under axial displacement in a helical winding to form said elongate spindle member,
- using chain links formed with a substantially circular curvature on their exterior sides and including associated engagement means,
- drivingly connecting said chain links to a rotatable driving device arranged in a winding guide means connected with one of said two objects,
- guiding said chain links during rotation of said driving device in said winding guide means so that the chain links are interconnected and retained in engagement by their associated engagement means with neigh-

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14 03.12.99

bouring chain links in the same turn as well as adjacent chain links in neighbouring turns of said elongate spindle member, and

- coupling the helical winding with the other of said two objects by means of a coupling member.

By winding mutually interlocked chain links in this manner in a helical winding under active retainment of the individual chain links in their positions in the helical winding, it has turned out to be possible to provide a spindle device having significant stability against pressure and/or tensile loads as well as bending and torsional loads and which may act as a pressure bar or drawbar or torque shaft between two objects.

According to a preferred embodiment of the method of the invention a reversibly rotatable driving device is used, said device increasing by rotation in one direction of rotation the length of the spindle device during winding of the chain links in said helical winding and reduces by rotation in the opposite direction of rotation the length of the spindle device during unwinding of the chain links from said helical winding.

Further embodiments of the method and non-exhaustive examples of its application are described in the dependent claims 2 - 11.

For carrying out the method the apparatus according to the invention is characterized in comprising, in connection with one of said two objects, a chain storage with an elongate chain of interlocking chain links having a substantially circular curvature on their exterior sides and including associated engagement means, a guide means for advancing the elongate chain, a winding guide means connected with the advancing guide means and comprising a guide for engagement

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with a guide member on the chain links for winding said helical winding a rotatable driving device arranged in said winding guide means axial advancement of the spindle device produced by the helical winding and a coupling member for coupling the helical winding with the other of said two objects.

Advantageous embodiments of the apparatus and non-exhaustive examples of use are described in the dependent claims 13 to 34.

The invention further relates to an elongate chain comprising interlocking chain links with associated engagement means for use in the apparatus.

According to the invention the elongate chain is characterized in each chain link has a substantially circular curvature on its exterior sides and, in unfolded projection, substantially the shape of a parallelogram with a first pair of engagement means for connection with neighbouring chain links in the same turn of the helical winding provided at a first pair of opposite sides and further engagement means for engagement with corresponding engagement means on adjacent chain links in neighbouring turns of the helical winding provided at a second pair of opposite sides.

The invention will be explained in the following by means of an embodiment and with reference to the partly schematic drawing, in which

Figs 1 and 2 are schematic, perspective views illustrating the principle of the method according to the invention,

Figs 3 and 4 show an embodiment of an apparatus according to the invention,

Fig. 5 shows an embodiment of the apparatus with integrated chain storage,

Figs 6 and 7 show embodiments of a winding guide means and a drive means in the apparatus according to

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Figs 3 and 4,

Figs 8 - 12 show an embodiment of a chain link for use in the apparatus according to Figs 3 and 4,

Fig. 14 is a perspective view illustrating the winding up of the interlocking chain links in a helical winding under mutual retainment,

Fig. 15 is a schematical perspective view of a first alternative embodiment, in which two spindle members of equal diameter are formed by individual helical windings produced from individual sets of chain links,

Fig. 16 is a schematical sectional view of a second alternative embodiment, in which two spindle members of different diameter are formed by individual helical windings produced from individual sets of chain links and extending one inside the other,

Fig. 17 is a schematical perspective view of an alternative embodiment, in which a single spindle device is formed from two individual sets of chain links, and

Fig. 18 is a perspective view of the application of the embodiment shown in fig. 15 in a window operator device.

As will appear from figs 1 and 2, the invention resides in its broadest aspect in that chain links 1,